

## SITE INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98  
Geographic Region: South America  
Tectonic Plate: South American

General Site Description: The site is located in Western South America in Southern Peru at the Smithsonian Astronomical Observatory. The University of August has been operating the SAO-2 Laser since 1965. A pad compatible for occupation by a TLRS was constructed on the site. Arequipa is one of the few laser stations located in the Southern Hemisphere and is critical for measurements determining polar motion.

Local Geology: Quaternary alluvium overlying granodioritic upper cretaceous lower tertiary coastal batholith. This batholith contains faulted inliers of precambrian gneiss.

Site Topo Map: Unknown

## CONTACT INFORMATION

Site Ownership: PERU  
Site Management: Universidad Nacional de San Agustin - (UNSA), under contract to NASA/ GSFC  
Mr. David Hallenbeck  
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# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
 Location: Arequipa, Peru  
 Site Number: 98  
 Number of Observing Monuments: 2  
 Surveyed into National Network? No

Monument Number: 7403  
 Type of Monument: Concrete wit brass disk  
 Monument Inscription: 7403 89  
 Systems using Monument: Mobile Lasers

Latitude: S 16° 27' 56.58287"  
 Longitude: W 71° 29' 34.64012"  
 Elevation: 2447.610 meters  
 Height above Ellipsoid: 2488.858 meters  
 Geodetic Coordinate Source/Date: ATSC / 01-FEB-92  
 Geodetic Coordinate Datum/Ellipsoid: IERS ITRF94 (1993)  
 Elevation Datum: Unknown

Source of Monument Geodetic Survey Ties: ATSC - NASA SLR

Comments: This monument is on the new pad constructed in 1988 for TLRS-3 occupation.

## Differential Coordinates

Monument Number	Monument Inscription	X	Y	Z
4021	JPL 4021-S	18.615	-0.548	21.499
7907	—	-16.021	-7.914	-3.651
—	DORIS	-11.368	-8.020	-3.627
—	7403 PIER A	29.063	-20.249	99.769
—	7403 PIER B	81.282	5.785	67.672
—	7403 PIER C	267.414	169.172	-281.138
—	7403 PIER D	-25.105	5.547	-44.424
—	7403 RM1	-2.135	-14.007	48.658
—	7403 RM2	30.564	11.728	1.274
—	EST SATELITE	-23.075	-11.900	4.458
—	EST SATELITE AZ MARK	367.988	310.488	-673.910

Monument Number	Monument Inscription	North	East	Up
4021	JPL 4021-S	22.439	17.479	0.068
7907	—	-2.815	-17.704	3.357
—	DORIS	-2.345	-13.325	4.862
—	7403 PIER D	-46.351	-22.048	-0.091
—	7403 RM1	50.235	-6.470	-1.706
—	7403 RM2	0.818	32.706	-1.726
—	EST SATELITE	5.398	-25.658	2.536

# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98  
Monument Number: 7403

## Monument Description:

The station is located in the South American country of Peru. It is approximately 5.2 miles southeast of the city of Arequipa and 0.6 miles Northwest of the small town of Characato.

The station mark is a standard NASA-GSFC brass disk set flush near the center of a 1.2 x 1.2 meter isolated concrete pad that is set in the north end of a 8.2 x 7.6 meter concrete pad. The disk is stamped "7403 89". The pad is located inside a 19.8 x 24.4 meter fenced area that is located just East of the Smithsonian Astrophysical Observatory (SAO-2) buildings which are operated by the San Agustin University.

Reference mark 1 is a standard NASA-GSFC brass disk set flush in the center of a 0.46 x 0.34 meter concrete monument that projects above a 0.5 meter diameter concrete mass that is flush with the ground. The disk is stamped "7403 RM1 89". It is located at a distance of 50.6 meters and at a geodetic azimuth of 353 degrees.

Reference mark 2 is a standard NASA-GSFC brass disk set flush in the center of a 0.40 x 0.33 meter concrete monument that projects above a 0.6 meter diameter concrete mass that is flush with the ground. The disk is stamped "7403 RM2 89". It is located at a distance of 32.7 meters and at a geodetic azimuth of 89 degrees.

Four laser system calibration piers were set and established for station 7403 in April 1989. Imbedded into the top of each calibration pier is a 0.025 meter diameter stainless steel insert. The exact center of these inserts represent the plumb point of the control station, and the lip of the inserts represent the elevation point. To plumb exactly over the point requires a Wild tribrach (part # 1399775), with footscrew disks (part # 4130486). Used in conjunction with these are is a Wild centering ball (part # 4911411) which adapts to the tribrach and force fits into the insert imbedded into the calibration piers, insuring exact plumbing once the tribrach is leveled. In February 1994, "7403 Calibration Pier B" was modified. A 0.254 meter diameter stainless steel plate was installed on top of the pier. The plate contains a 5/8 - 11 standard survey stud that will accept a standard survey tribrach.

7403 calibration pier 1 (target A) is a 0.35 x 0.33 meter concrete monolith that extends 1.89 meters above the ground. It is located at a distance of 105.8 meters and at a geodetic azimuth of 12 degrees.

7403 calibration pier 2 (target B) is a 0.34 x 0.34 meter concrete monolith that extends 2.23 meters above the ground. It is located at a distance of 105.9 meters and at a geodetic azimuth of 48 degrees.

7403 calibration pier 3 (target C) is a 0.34 x 0.34 meter concrete monolith that extends 1.82 meters above the ground. It is located at a distance of 423.1 meters and at a geodetic azimuth of 133 degrees.

7403 calibration pier 4 (target D) is a 0.33 x 0.33 meter concrete monolith that extends 1.85 meters above the ground. It is located at a distance of 51.3 meters and at a geodetic azimuth of 205 degrees.

# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98  
Monument Number: 7403

Monument Description: The azimuth mark is a standard "Geodesico Inter-Americano" IGM Peru brass disk set flush in the top South center of a large 3.0 x 1.5 meter boulder that extends 1.0 meters above the ground. The disk is worn and bent into the shape of the boulder surface and is stamped "EST-SATELLITE 1961 MAR. AZIMUT". It is located approximately 23 meters Northeast of the summit of a small knoll upon which has been constructed a circular rock compound, and approximately 17 meters west of a red brick wall that surrounds a house area. To reach the azimuth mark from the entrance to the University of San Agustin Observatory compound, proceed South-east on "Carretera A Yaramama" for 0.25 miles to an intersecting road on the left (East). Turn left onto this road and proceed East for 0.20 miles to a small concrete aqueduct that passes beneath the road at the edge of a small village. Here at a "Y" fork, take the left fork through the village for 0.45 miles. At this point proceed on foot Southeast toward the summit of the hill for approximately 120 meters to the station site located East of the hill summit.

Two other survey control marks are located in the immediate vicinity of control station 7403.

Survey control point "EST-Satelite" is a standard "Geodesico Inter-Americano" IGM Peru brass disk set flush with the roof of the University of San Agustin SAO-2 laser operations and administration building. The disk is stamped "EST-SATELITE 1961". It is set 5.73 meters South of the North inside edge of a 0.4 meter high concrete abutment that projects above the roof, 2.02 meters East of this abutment, and 2.30 meters West. The roof is 3.15 meters above ground level. Survey control point "EST-Satelite" has two reference marks. Both are standard "Geodesico Inter-Americano" brass reference disks.

(1) Reference mark 1 is set flush in the roof of the SAO-2 laser building. The disk is stamped "EST. SATELITE 1961 MAR. REF. 1". From control station "EST-Satelite" it is located at a distance of 14.43 meters and at a geodetic azimuth of 97 degrees and 16 minutes.

(2) Reference mark 2 is set flush in the roof of a University of San Agustin building located south of the operations and administration building. It is located outside the fence surrounding the SAO-2 compound. The disk is stamped "EST SATELITE 1961 MAR. REF. 2". From control station "EST Satelite" it is located at a distance of 34.62 meters and at a geodetic azimuth of 197 degrees and 06 minutes.

Survey control point "BM. CHR-5" is a standard "Geodesico Inter-Americano" brass disk. It is set 0.002 meters below the surface of the sidewalk on the East side of the SAO-2 operations and administration building. The disk is stamped "BM. CHR-5 1961". It is located just South of the first doorway entrance from the North end of the building, 0.120 meters East of the building, and 1.170 meters West of the edge of the sidewalk.

# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98

Monument Number: 7907  
Type of Monument: Rotation Axes of Laser  
Monument Inscription: None  
Systems using Monument: SAO-2 Fixed Laser

Latitude: S 16° 27' 56.67443"  
Longitude: W 71° 29' 35.23676"  
Elevation: 2450.960 meters  
Height above Ellipsoid: 2492.213 meters  
Geodetic Coordinate Source/Date: ASTC / 01-FEB-92  
Geodetic Coordinate Datum/Ellipsoid: IERS ITRF94 (1993)  
Elevation Datum:

Source of Monument Geodetic Survey Ties:

Comments: The system is also referenced as Arelas.

## Differential Coordinates From 7907

Monument Number	Monument Inscription	X	Y	Z
4021	JPL 4021-S	34.636	7.366	25.150
7403	CDP STATION 7403	16.021	7.914	3.651
—	7403 PIER C	283.435	177.086	-277.487
—	7403 PIER A	45.084	-12.335	103.420
—	7403 PIER B	97.303	13.699	71.323
—	7403 PIER D	-9.085	13.461	-40.772
—	7403 RM1	13.886	-6.093	52.309
—	7403 RM2	46.585	19.642	4.925
—	DORIS	4.653	-0.106	0.024
—	EST SATELITE	-7.054	-3.986	8.109
—	EST SATELITE AZ MARK	384.008	318.402	-670.259

Monument Number	Monument Inscription	North	East	Up
4021	JPL 4021-S	25.253	35.183	-3.289
7403	CDP STATION 7403	2.815	17.704	-3.357
—	7403 PIER D	-43.536	-4.344	-3.448
—	7403 RM1	53.050	11.235	-5.063
—	7403 RM2	3.633	50.410	-5.083
—	DORIS	0.470	4.379	1.505
—	EST SATELITE	8.213	-7.954	-0.821

# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98  
Monument Number: Flinn 4021-S 1994

Monument Description: The station is located in the South America Country of Peru. It is approximately 5.2 miles southeast of the city of Arequipa and 0.6 miles Northwest of the small town of Characato.

The station mark is a 0.457 meter diameter stainless steel plate set flush in the top of a 0.9 x 0.9 meter concrete pier that extends 0.52 meters above the ground. The plate is etched "**AREQUIPA, PERU GPS STATION MARK JPL 4021-S 1994**". The pier is located in an open area to the Northeast of the NASA Arequipa Tracking Station operations building complex within the University of San Agustin Observatory. It is set approximately 20.1 meters North of the Northeast fence corner of the NASA CDP station enclosure, 19.8 meters Northeast of the Northwest corner, and 8.5 meters Southeast of a sidewalk extending between the complex and the University magnetic observatory building.

Reference mark 1 is a standard NASA-GSFC brass disk set flush in the center of a 0.46 x 0.34 meter concrete monument that projects above a 0.5 meter diameter concrete mass that is flush with the ground. The disk is stamped "**7403 RM1 89**". It is located at a distance of 36.7 meters and at a geodetic azimuth of 319° from the station mark.

Reference mark 2 is a standard NASA-GSFC brass disk set flush in the center of a 0.40 x 0.33 meter concrete monument that projects above a 0.6 meter diameter concrete mass that is flush with the ground. The disk is stamped "**7403 RM2 89**". It is located at a distance of 26.4 meters and at a geodetic azimuth of 145°.

Reference mark 3 is a standard NASA-GSFC brass disk set flush near the center of a 1.2 x 1.2 meter isolated concrete pad that is set in the North end of a 8.2 x 7.6 meter concrete pad. The disk is stamped "**7403 89**". The pad is located inside a 19.8 x 24.4 meter fenced area that is located East of the University of San Agustin Observatory/NASA Arequipa Tracking Station administration and operations buildings. It is located at a distance of 28.4 meters and at a geodetic azimuth of 218°.

One additional survey control mark is located in the immediate vicinity of control station "**JPL 4021-S 1994**".

Survey control point "**EST-Satelite**" is a standard "*Geodesico Inter-Americano*" IGM Peru brass disk set flush with the roof of the NASA Arequipa Tracking Station/University of San Agustin Observatory operations and administration building. The disk is stamped "**EST-SATELITE 1961**". It is set 5.73 meters South of the North inside edge of a 0.4 meter high concrete abutment that projects above the roof, 2.02 meters East of this abutment, and 2.30 meters West. The roof is 3.15 meters above ground level. It is located at a distance of 46.4 meters and at a geodetic azimuth of 248°. Survey control point "**EST-Satelite**" has two reference marks. Both are standard "*Geodesico Inter-Americano*" brass reference disks.

(1) Reference mark 1 is set flush in the roof of the University of San Agustin Observatory SAO-2 laser building. The disk is stamped "**EST. SATELITE 1961 MAR. REF. 1**". From control station "**EST-Satelite**" it is located at a distance of 14.4 meters and at a geodetic azimuth of 097°.

(2) Reference mark 2 is set flush in the roof of a University of San Agustin building located south of the operations and administration building. It is located outside the fence surrounding the University of San Agustin Observatory/NASA Arequipa Tracking Station complex. The disk is stamped "**EST SATELITE 1961 MAR. REF. 2**". From control station "**EST Satelite**" it is located at a distance of 34.6 meters and at a geodetic azimuth of 197°.

# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98  
Monument Number: 7403 SW 1994

Footprint Information: The station is located in the South America country of Peru. It is set approximately 16.5 kilometers Southwest of Arequipa, Peru, 17.8 kilometers South of the Arequipa "Rodriguez Baltan Airport", and along the new portion of the highway to the Cerro Verde Mine.

The station mark is a punchmark in the round top of a stainless steel pin. The pin is grouted into the top of the South section of a 0.3 x 0.5 meter granite outcrop that is flush with the old scrapped road bed. It is set 1.1 meters East of a steep slope that extends down to a rock bluff, and 2.0 meters West of a very steep slope/bluff that extends down approximately 15.2 meters to the paved road. From the station, a many stalked cactus is visible on a higher peak to the Northwest at a magnetic azimuth of 330 degrees and at a distance of 120 meters, and a quarry on a higher peak to the Southeast at a magnetic azimuth of 141 degrees.

Reference mark one is a standard NASA/GSFC brass disk grouted flush into the top of a 0.2 x 0.4 meter granite outcrop that is flush with the old scrapped road bed.. The disk is stamped "**7403 SW 1994**". It is set 1.6 meters East of a steep slope that extends down to a rock bluff, and 2.1 meters West of a very steep slope/bluff that extends down approximately 15.2 meters to the paved road. It is at a horizontal distance of 9.861 meters and at a magnetic azimuth of 317 degrees from the stainless steel pin.

Note: This is a short pack station. The driving time from the NASA Arequipa tracking station requires from 40 to 50 minutes.

The Gerente of Operations at the "Cerro Verde Mine", Mr. Mauro Cerpa Amado, should be notified prior to station occupation. It may be necessary to give your name and purpose for the visit to the "Cerro Verde Mine" guard post.

Archive of Site Survey  
Data:

# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98  
Monument Number: 7403 NW 1994

**Monument Description:** The station is located in the South America country of Peru. It is set approximately 6.6 kilometers Southwest of Arequipa, Peru, 10.2 kilometers South of the Arequipa "Rodriguez Baltan Airport", and 1.8 kilometers Northeast of the town of Tiabaya on a low range of hills known as Chiriguana.

The station mark is a punchmark in the round top of a stainless steel pin. The pin is grouted into the top of a large red rock outcrop that is flush with the ridgeline on the East and forms a bluff on the West. It is set 4.8 meters East of the West edge of the bluff, 5.0 meters South of the North edge, and 4.1 meters North of the flat edge of a large red stone rock outcrop that extends approximately 1.0 meters higher than the station. It is 50 meters above the dirt access road and from the station a wooden cross on the higher North peak is at a magnetic azimuth of 341 degrees and 30 minutes and the higher South peak at 165 degrees.

Reference mark one is a standard NASA/GSFC brass disk grouted flush into the top of the large flat red rock outcrop. The disk is stamped "7403 NW 1994". It is set 1.2 meters South of the North edge of the rock bluff and at a horizontal distance of 3.536 meters and a magnetic azimuth of 29 degrees and 30 minutes from the stainless steel pin.

**Note:** This is a pack station. The driving time from the NASA Arequipa tracking station requires from 30 to 40 minutes.

The mayor of the municipal District of Sachaca should be notified prior to station occupation.



# MONUMENT INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98  
Monument Number: 7403 SE 1994

Footprint Information: The station is located in the South America country of Peru. It is set approximately 12.7 kilometers Southeast of Arequipa, Peru and 3.0 kilometers Southeast of the small town of Characato. It is on an East-West ridgeline above and South of the Rio Mollebaya and East of the small village of Mollebaya.

The station mark is a punchmark in the round top of a stainless steel pin. The pin is grouted into the top of an irregular shaped (*0.9x0.6x1.9 meter*) rock outcrop that is flush with the ground on the West side and 0.65 meters above the slope of the ground on the East side. It is set approximately 2.7 meters North of a large white rock outcrop that extends approximately 1.7 meters higher than the station, 14 meters North of the top of a small knoll, and 190 meters Southeast of the "*Cross of Mollebaya*". It is 22 meters above the dirt access road and from the station the "*Cross of Mollebaya*" is at a magnetic azimuth of 294 degrees and 30 minutes, "*Mount Misti*" at 16 degrees and a large concrete tank on a ridgeline at 124 degrees.

Reference mark one is a standard *NASA/GSFC* brass disk grouted flush into the top of a large white colored rock outcrop that extends approximately 0.5 meters above the ground on the West side. The disk is stamped "**7403 SE 1994**". It is set at a horizontal distance of 7.734 meters and at a magnetic azimuth of 317 degrees and 50 minutes from the stainless steel pin.

The Mayor of the village of Mollebaya should be notified prior to station occupation.

Archive of Site Survey  
Data:

# SITE SKETCH

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98

## PREVIOUS OCCUPATION INFORMATION

Revised: 5/01/98

Current Site Name: Arequipa  
Location: Arequipa, Peru  
Site Number: 98

### SLR Occupations

Monument Number	Occupying System	Occupation Designator	Starting Date	Ending Date
7403	TLRS-3	74031301	14-Jun-90	24-Oct-90
7403	TLRS-3	74031302	26-Mar-91	15-Oct-91
7403	TLRS-3	74031303	14-Jul-92	_____
7907	SAO-2	79074001	01-Sep-70	14-Jun-88
7907	SAO-2	79074002	15-Jun-88	01-May-91
7907	SAO-2	79074003	18-Oct-91	_____

### VLBI Occupations

Monument Number	Occupying System	Occupation Designator	Starting Date	Ending Date
No Previous Occupations				

### GPS Occupations

Monument Name	Starting Date	Ending Date	Network
AREQ	31-Jan-94	-----	IGS

### Footprint Surveys

Survey	Starting Date	Source
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No footprint surveys were completed. See the station description notes for geodetic ties to other local geodetic stations.